STANDARDIZED INTERIM PROGRESS REPORT

A. Project Identifiers:

1) Award Number:	NA17FX1429
2) Grant Program / CFDA:	11.439
3) Name of Recipient Organization:	Texas A&M Research Foundation
4) Principal Investigator:	Markus Horning

5) Project Title:
Satellite-Linked Mortality Transmitters in Steller Sea Lions: Assessing the Effects of Health Status, Foraging Ability and Environmental Variability on Juvenile Survival and Population Trends.

6) Funding:	Federal: $1,046,906 Match: $ 19,500 (excluding NOAA holdback for NMFS tasks)
7) Award Period:	June 1st, 2001 through May 31st, 2004
8) Period Covered by this Report:	June 1st, 2001 through November 30th, 2001

B. Project Summary:

One of the leading hypotheses for the continuing decline of Steller sea lions in the Aleutian Islands (AI) and Gulf of Alaska (GoA), is a decrease in juvenile survival by 10 - 20%. Nutritional stress related to a reduced juvenile foraging efficiency has been hypothesized as a possible cause for reduced juvenile survival. The hypothesized reduction in juvenile survival, however, is derived from a model based on a Leslie population matrix. This matrix is in turn based on observed rates of decline, observed changes in average age of adult females, and estimates of age-specific fecundity. This hypothesized reduction in juvenile survival, resulting in a reduced recruitment into the reproductively active rookery population, has been used to focus investigative efforts relating to the Steller sea lion decline primarily on juvenile animals. To warrant a continued focus of investigative effort on juvenile stellers, juvenile mortality figures need to be accurately determined.

Mortality figures are key indicators of future population trends, and are crucial data for the management of endangered species and those potentially exposed to detrimental ecological and anthropogenic environmental changes, or climate related regime shifts. In addition, data on individual survivorship is needed to assess the efficacy of programs designed to ameliorate the impact of such changes and shifts. Survival of juvenile animals is bound to impact recruitment and thus reproductive output of rookeries. On a population level, survival figures are integrators over several possible proximate effects that could contribute to the population decline, such as disease and pollution, predation as well as a reduction in foraging efficiency due to changes in prey abundance and/or quality. Thus, survival figures can be utilized to monitor a population, irrespective of which proximate causes contribute (with some exceptions) to the population decline. Furthermore, mortality rates are expected to reflect nutritional stress or other proximate factors detrimental to a population several years before ultimate effects such as reduced pupping rates / pup counts become apparent (the latter presumably through a drop in recruitment).

We will specifically measure juvenile mortality, and thus directly test a crucial component of the leading hypothesis for the continuing population decline in Stellers, using implanted Satellite-linked Mortality Transmitters (SMXs). Mortality transmitters are a well established technique to determine survival rates in wild animals. Our approach is new in that conventional mortality transmitters are externally attached and typically utilize VHF radio transmission. Several problems are associated with such devices: on pinnipeds and seabirds, external units do not remain attached beyond the annual molt, limiting tracking to a maximum of one year. Battery-size and -capacity constraints also limit the life span of such units. Implanting mortality transmitters avoids long-term attachment problems. Implanted telemetry devices have been successfully used on a wide range of marine endotherms, and circumvent external attachment limitations. However, reception range and thus area coverage from VHF implants is reduced compared to external devices. Transmitting life span is still limited to 2-3 years.

A new solution to extend coverage range for mortality transmitters is the use of satellite-linked devices. Satellite-linked data loggers, using the Service ARGOS system aboard NOAA satellites for obtaining location fixes and transmission of stored data have been successfully and extensively used on oceanic vertebrates. At present however, transmission to a satellite from implanted devices is not feasible. To circumvent this problem, the concept of implanted, satellite-linked, delayed transmission mortality transmitters (SMX tags) has been developed at Texas A&M University's Laboratory for Applied Biotelemetry & Biotechnology. SMX devices continuously monitor up to five built-in sensors to establish death of an instrumented animal, then store time and date of death in memory. Subsequently, an SMX device transmits this and other previously stored data to an orbiting ARGOS satellite, once the positively buoyant device has been released from the decomposing or consumed body. Through the absence of *any*

transmissions, until after death and release of the device, battery life is greatly extended to well beyond five years, typically 8-10 years.

We will implant satellite-linked mortality transmitters (SMX tags) into 60 free-ranging juvenile Steller sea lions, and an additional 12 animals temporarily held at the Alaska Sea Life Center. We will perform comprehensive assessments of the status of body condition, health and immune system, and pollutant levels. From the SMX tags we will determine: time and date of death and weekly cumulative foraging effort from implantation until death.

In a new experimental paradigm, we will analyze differences between survivors and non-survivors in condition and health status at the time of release, as well as seasonal, interannual and ontogenetic dive effort. We will test the predictive power of health, condition and behavioral parameters measurable after weaning, on future survival and thus population trends.

C. Summary of Progress and Results:

Non-scheduled activities:

A permit to conduct the proposed research under the MMPA / ESA has been applied for under the leadership of the Alaska Sea Life Center (ASLC). This permit is currently in review. The sampling being presently conducted (see below) is permitted under the existing sampling / health assessment permit of the ASLC.

Tasks scheduled for the reporting period:

These tasks were scheduled for this reporting period:
Task 1 (10 months): Preparation and calibration of SMX tags.
Task 2 (10 months): Preparation and design of health assessments.

Task 1 has been delayed by about 6 months. This delay is the result of a joint decision by the Laboratory for Applied Biotelemetry & Biotechnology (LABB) at Texas A&M University and the tag manufacturer Wildlife Computers (WC) to switch to a different type of ARGOS transmitter board for use within the SMX tags. The rationale for this switch lies in the significantly smaller size, as well as the improved efficiency, transmission power and reliability of the new transmitter boards. This will result in much smaller SMX tags than our initial protoypes. We feel that this size reduction is ample justification for the associated delay, since it will significantly reduce the likelihood of creating negative effects by the SMX implants on the experimental animals, and of thereby affecting the very data we are aiming to collect. The new transmitter boards have been tested as stand-alone units, but have not been integrated into the SMX tags. This will be accomplished during the next joint project period by LABB and WC in February of 2002. We are currently planning on having new generation prototypes available in April of 2002. The programming of SMX tags has been completed, and the mortality algorithms have been successfully tested in simulation runs using a separate simulation software package developed for this purpose.

Task 2 is continuing on schedule. We have completed the purchase of the portable hematology and clinical chemistry analyzers. Both units are in use at the Alaska Sea Life Center.

On the three resident Steller sea lions held at the ASLC, routine blood samples were collected and analyzed for standard hematology and clinical chemistry parameters. Stock blood and fecal samples from Steller sea lions are being analyzed for levels of the stress hormone cortisol. This will permit the comparison of the suitability of these two types of samples to assess stress levels in sea lions. The goal is to use fecal samples - if possible - to monitor stress levels in implanted vs non-implanted animals. Cortisol-, hematology and clinical chemistry analyses currently conducted under task 2 will contribute to the baseline data for health and stress level assessments. Evaluation of all data collected so far will continue, and we do not have any results to report at this stage.

D. Problems:

As outlined above in relation to task 1, the preparation of the SMX tags has been delayed by 6 months. Rather than being the result of unanticipated problems, this was a specific decision we made to provide significant improvements to the project and reduce the likelihood of adverse effects on experimental animals and data.

In addition, the capture program for juvenile Steller sea lions to be held in temporary captivity at the ASLC prior to release is likely to experience delays, since the construction of the holding facility at the ASLC has not been initiated yet. Accessibility to these animals for the implantation of SMX devices under highly controlled conditions (Task 3) will be an important step prior to the application of SMX tags to free-ranging Steller sea lions. It is likely that the combination of the delays in Task 1 and Task 3 (the latter resulting from the delay in the "transient program" facility construction) will push the implantation of SMX tags into free-ranging Stellers into calendar year 2003. However, we feel that minimization of SMX tag size and optimization of tag design, as well as successful testing of SMX tags under highly controlled conditions on transient Stellers at the ASLC are sufficiently important to warrant this change in task schedules, and will ultimately contribute to the success of the project.

<u>Additional changes:</u>
Dr. Mellish, co-Principal Investigator on this project, has left Texas A&M University and accepted a position as marine mammal scientist at the ASLC (with a joint appointment as Research Assistant Professor at the University of Alaska Fairbanks). To accomodate this move, we have requested the transfer of a portion of project funds to Dr. Mellish at the ASLC by means of a subcontract under the Texas A&M grant. This change has just been approved by NMFS / NOAA. We are in the process of finalizing the contract agreement between the ASLC and Texas A&M.

None of the above listed changes will have any effect on the overall cost of the project.

<u>New nomenclature:</u>
We have decide to re-name the mortality transmitters to: life-history transmitters, and to change the acronyms accordingly from SMX to LHX tags. This is to reflect the fact that the LHX tags in effect transmit far more data than mere mortality events (data related to the life history of the animals), and therefore represent an entirely new type of transmitter device. Accordingly we will

replace "satellite-linked mortality transmitters" with "satellite-linked life-history transmitters" and SMX with LHX in all future texts and correspondence. We would also like to request a change in the title of our project to reflect this new tag designation. The proposed new project title is:

"*Satellite-Linked Life-History Transmitters in Steller Sea Lions: Assessing the Effects of Health Status, Foraging Ability and Environmental Variability on Juvenile Survival and Population Trends*."